9040-63-646
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COR-2199
COPY 1 OF 3

Jim

3 May 1963

25X1A [redacted]
USAF
Director 622A Program
Los Angeles, California

Gentlemen:

Under separate cover you have received copies of a TECHNICAL PROPOSAL FOR STRIP CAMERA RECONNAISSANCE SATELLITE which was prepared jointly and submitted by Itek Corporation and its proposed Associate Contractor, Lockheed Missiles and Space Company. Itek is now pleased to submit additional information necessary to complete its portion of the Strip Camera Program Proposal.

Enclosed herewith are two (2) booklets which contain these data. The first booklet details our Development Plan, Work Statement, and Specification which describes the manner in which Itek will implement and perform the proposed program. The second booklet contains our Cost Proposal which identifies the various significant portions of the program and their estimated costs. Since the submission on 22 March 1963 of our Preliminary Technical Proposal (our document no. 9040-63-582), we have continued our joint working meetings with our proposed associate, Lockheed. These meetings have resulted in a more detailed solution to our mutual interfaces, deliverables as contained in our Work Statement, and an integrated Schedule which presumes two awards of a contractual authorization to proceed by 1 June 1963.

The most significant changes resulting from this additional joint effort are the change from an f/6 to an f/5 system and the inclusion of the stereo capability in the initial design concept. We have also revised the period of Itek's performance from eleven (11) to fourteen (14) months, for the time of go-ahead to delivery to A/P of our first system.

Another change from our original plan is the submission for your consideration of an Atmospheric Resolution Tester to be installed on the West Coast for the purpose of final, pre-flight, and photo performance verification.

25X1A [redacted] 3 May 1963

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[redacted]

Our personnel are available and would appreciate the opportunity to join with Lockheed Missiles and Space Company and present to you a briefing in which we would describe in more detail the features of the Technical Proposal. [redacted] should be contacted for purposes of arranging this briefing.

STATINTL

We trust this proposal will meet with your approval.

Very truly yours,

ITEK CORPORATION

[redacted]
President

25X1A

Enclosures (4)

25X1A

cc: [redacted] - 4 w/4 each.
- 3 w/3 each.
1 w/1 each.
File

APPENDIX A

PRELIMINARY STRIP CAMERA SUBSYSTEM ASSEMBLY LIST

CAMERA

1. Structure
   a. Transport and Supply Spool Mounting
   b. Forward - Diagonal Mirror and Lens Mounting
   c. Support Tube - Primary Mirror Mounting
   d. Shell - Corrector Plate Mounting

2. Optics
   a. Primary Mirror and Bezel
   b. Diagonal Mirror and Bezel
   c. Corrector Cell
   d. Corrector Plate and Bezel

3. Transport - Film
   a. Supply Spool and Drive
   b. IMC Drum and Drive
   c. Supply and Take-up Dancers
   d. Tension Assemblies
   e. Auxiliary Data Head
   f. Shutter and Capper

4. Take-up Cassette
   a. Cassette
   b. Take-up Spool and Drive
   c. Sensor Arm

5. Optical Drive
   a. Roll Steering Correction
   b. Stereo - Diagonal Mirror and Corrector Plate

6. Light Baffles

7. Thermal Shielding

8. Cables

CAMERA (continued)

9. Electronics

a. Film Transport

1) Servo Amplifier
Supply
Take-up
Metering

2) Spool Drive Assembly
Supply
Take-up

3) Metering Drive Assembly

b. Control

1) Power Distribution and Control Assembly

2) S/I Control

c. Optical Drives

1) Roll Steering and Stereo Control

2) Roll Steering Drive

3) Stereo Drive

d. Auxiliary Data

1) Light-Up Control and Lamp Adjust

e. IMC Sensor

1) Vidicon Camera and Sweep Circuits

2) Video Signal Evaluation Unit

3) IMC Sensor Control Unit

HANDLING FIXTURES

1. Transport Assembly and Test Fixture
2. Spool Assembly and Test Fixture - Runout
3. Cassette Holding Fixture
4. Transport Alignment Fixture
5. Spooling Fixture - Dark Room
6. Horizontal Handling Fixture and Slings
7. Strong Back
8. Test and Assembly Dolly

SHIPPING CONTAINERS AND PROTECTIVE COVERS

1. Camera Transit Case
2. Cassette Transit Case

SHIPPING CONTAINERS AND PROTECTIVE COVERS (continued)

3. STM - Shipping Box
4. Structure Shipping Dolly
5. Space Mock-up - Shipping Box
6. Protective Covers
    a. Corrector Plate
    b. Corrector Cell - Both Ends
    c. Primary Mirror
    d. Diagonal Mirror
7. Thermal Unit Shipping Box
8. Protective Dust Covers

VIBRATION AND SHOCK FIXTURES

1. Lateral - Complete Unit
2. Longitudinal - Complete Unit
3. Cassette
4. Spool and Drive
5. IMC Drum and Drive
6. Transport Assembly
7. Corrector Cell
8. Corrector Plate
9. Electronics Assemblies
10. Centrifuge Fixture - Camera Subsystem
11. Roll Steering Correction Drive
12. Stereo Drive

DRILL JIGS

1. System - Subsystem Interface
2. Forward Structure and Support Tube Mating
3. Primary Mirror Mounting
4. Corrector Plate Bezel
    a. Corrector Plate Shell
5. Diagonal Mirror Bezel
6. Corrector Cell
7. IMC Drum to Corrector Cell
8. Supply Spool and Drive Mounting
9. IMC Drum to Drive
10. Supply and Take-up Dancers
11. Tensioning Assemblies
12. Complete Transport Assemblies
13. Cassette Plates
14. Roll Steering Correction Drive
15. Stereo Drive
16. Light Baffle Templates
17. Electronics Mounting and Mating to Structure

TEST MODELS AND MOCKUPS

1. Structural Test Model
2. Space Mockup
3. Quarter Scale Optical Model
4. Quarter Scale Thermal Model

PATS CHAMBER AND TEST EQUIPMENT

1. Processor Test Film Cassette
2. PATS Console
3. Checkout Console Modification Unit
4. Film Incher - Transport
    a. Light Jacket
5. Dummy Corrector Cell
6. PATS Chamber
    a. Test Area Layout
    b. Chamber
    c. Seismic Block
    d. Collimator Mirror
    e. Beam Splitter
    f. Target Drive
    g. Auto Collimator
    h. Interconnecting Cables
7. Thermal Test
    a. Thermal Enclosure
    b. Sensor Layout
    c. Lens Thermal Test Enclosure
    d. Reflector Structure Mount
    e. Interconnecting Cables

APPENDIX B

STRIP CAMERA OPTICAL TEST EQUIPMENT AND TOOLING

TEST EQUIPMENT

1. Final Optical Test Stand
2. Parabolic Frame
3. Knife Assembly
4. Mirror Test Frame
5. Parabolic Mirror
6. Flat Mirror
7. Spherical Mirror

JIGS, FIXTURES AND SPECIAL TOOLS

1. Special Size Draper
2. Modified LOH's
3. Berrylium Mirror Fabrication Support (Diagonal Mirror)
4. Mirror Fabrication Support (Primary Mirror)
5. Corrector Plate Fabrication Support
6. Cylinder Polisher
7. Field Corrector Adapter
8. Wedgeometer
9. Large Element Cutting Fixture
10. Flat Holder
11. Primary Mirror Grinding Tools
12. Corrector Plate Grinding and Polishing Tools
13. Mirror Polishers
14. Asepherizing Fixture

APPENDIX B

STRIP CAMERA OPTICAL TEST EQUIPMENT AND TOOLING

TEST EQUIPMENT

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6. Cylinder Polisher
7. Field Corrector Adapter
8. Wedgeometer
9. Large Element Cutting Fixture
10. Flat Holder
11. Primary Mirror Grinding Tools
12. Corrector Plate Grinding and Polishing Tools
13. Mirror Polishers
14. Asphering Fixture

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STEREO STRIP CAMERA DEVELOPMENT PLAN

The development of the Strip Camera System and required support equipment has been divided into five phases. Accomplishment of these phases is basically concurrent, however, paralleling of activity in and between each phase has been necessary to ensure a homogeneous effort and a unit delivery and program completion in the shortest time possible. The five program phases are as follows:

I - Subsystem Design and Development, Test Fabrication of Optics, and Model Units Design and Assembly.

II - Subassembly Design and Drafting, Fabrication and Procurement, and PATS Chamber Design, Assembly and Installation.

III - Subassembly of Qualification Units and Subassembly and Subsystem Qualification Testing.

IV - Assembly and Acceptance of first two units delivered.

V - Assembly and Acceptance of Qualification Units as deliverable units.

The milestone schedule on pages 6 and 7 indicates the basic spans of effort by phase described in this plan and the proposed delivery of the first flight unit fourteen months after program go-ahead.

PHASE I

Upon program approval, an intensive subsystem design effort will be initiated. The procurement time for lens glass, which experience has shown to be four to six months, dictates immediate optical design decisions so that this key long lead item can be ordered as soon as possible. A preliminary design freeze is therefore scheduled for two weeks following go-ahead. In addition, this will allow for a maximum

effort to be placed on the structural design, thermal control considerations, and electro-mechanical control and sensor requirements.

Both a lens and mirror test fabrication program will be started as soon as possible. The optical design requires that the optics, in addition to being large, be of a relatively unique configuration. The primary mirror will be polished having a rectangular opening in its center and the corrector lens will have a rectangular shape. Using glass which is immediately available and having similar working characteristics, various fabrication techniques will be tested early in the program. This will result in an ultimate savings of both time and material. Further it will provide necessary confirmation of details and introduce presently unforeseen problems as early in the program as possible. Similar fabrication and mounting tests will be conducted with quarter scale mirror blanks. These will then become part of the quarter scale optical STRIP model.

Two models of the STRIP camera are contemplated. Realizing the importance of the thermal problem, a scale thermal model will be fabricated, assembled, and tested to provide early experimental results and verify analytical thermal computations. This thermal mock-up will provide direct answers for mechanical and structural design consideration and will greatly increase confidence in the ultimate subsystem thermal design.

A quarter scale optical STRIP unit will be assembled using the test fabrication mirrors, adapted transport and electronics assemblies and a narrow field corrector lens. This unit, completed in five months, will allow basic optical testing in the presently installed DRT and provide hardware design answers for alignment, focus, exposure, and IMC.

PHASE II

A final interface freeze is scheduled two months following go-ahead. This action should clarify, up-date, and confirm all interface design parameters established by the preliminary interface freeze and allow for a camera subsystem design freeze. The major design and drafting

effort will now commence to provide from the layouts the detailed parts to be procured and fabricated. A list of major STRIP assemblies, handling fixtures, shipping containers, environmental test fixtures, and tooling is included as Appendix A to this development plan.

Optical glass for the first lens is scheduled in-house during the fifth project month. The receipt of this glass and the associated melt data will allow for completion and final modification of the lens design followed by fabrication of the test plates, polishing and figuring of the lens elements, and final lens assembly and test. The first lens, based on the cycle described, is scheduled to be complete in eleven months from the start of the program. Previous design and manufacturing experience with similar high acuity optical systems substantiates the time spans here proposed.

Initial design release of the STRIP camera structure for procurement of a structural test model (STM) is scheduled two months after go-ahead when the final interface freeze has been established. After receipt of the first STM in the sixth month and upon installation of mass simulation, this structure will immediately commence subassembly environmental qualification.

In order to provide adequate optical testing of the STRIP camera optical system, a STRIP Photo Altitude Thermal Simulation (PATS) Chamber will be designed and installed at Itek, Boston. This unit will have the capability of optically testing the STRIP camera alone and as a complete system under a vacuum condition of 1×10^{-4} inches. In addition, provision for environmental thermal gradient testing will be provided. A STRIP Atmospheric Resolution Tester (ART) will also be installed at the West Coast facility. This unit would, however, not have the vacuum and thermal test capability of the Boston PATS Chamber. Delivery of the first STRIP Camera requires the Boston PATS Chamber to be complete in twelve months and the West Coast ART Chamber complete in fourteen months upon first camera delivery. The present Itek Lexington Test Facility includes a high-bay test area containing shock and vibration test equipment and adjoining this on one side is a panoramic camera DRT, operational area, offices, and darkroom facility. The installation of

the Boston PATS Chamber in the existing facility next to the high-bay area and opposite the panoramic camera DRT is proposed and contemplated. This will allow maximum utilization of existing equipment both capital and project GSE.

PHASE III

The parallel procurement, fabrication, and subassembly of parts and components for Units 1 and 2 provides both test and manufacturing flexibility. With multiple units available, the effect of minor failures and assembly variations is minimized. After successful qualification testing critical subassemblies of Unit 1 are available for back-up use on Units 2 and 3, therefore further ensuring the meeting of the first delivery commitment.

The subassembly qualification test program proposed consists of vibration and shock testing of all significant subassemblies. The testing will be divided into three main parts. The first is the environmental testing of the structural test model. The second is the environmental testing of all major electrical and mechanical subassemblies. The third is the environmental testing of the optical and transport assemblies. The optical test assembly will be provided with the optical system that will become part of Unit 2 when the subassembly qualification is complete. This is necessary due to the optical fabrication and assembly lead time and the extensive duplication of expensive tooling that would be required in order to produce two optical systems in parallel. As a result, each STRIP optical system can be produced every 6 to 8 weeks. A list of required optical test equipment and tooling is included as Appendix B to this development plan.

PHASE IV

Actually parallel with Phase III, the production and test of Units 3 and 4 is scheduled to make maximum use of both time and facilities. Unit 3, being the first deliverable flight unit, is gated by the successful completion of subassembly qualification tests and the installation and readiness of the PATS Chamber. Acceptance testing of Unit 3 in the PATS Chamber will commence at the end of the thirteenth project month and is scheduled for a period of one month. This allows

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EXHIBIT "A"

TO STRIP CAMERA PROPOSAL

A. Contractor shall furnish the necessary facilities, materials, and services to accomplish the Statement of Work set forth below and make delivery to the Government at the times and places specified herein below:

STATEMENT OF WORK

Item 1 - Design, develop, and fabricate four (4) each Stereo Strip Cameras incorporating the four (4) GFE Stellar/Index Cameras in accordance with Contractor's Specification No. 49849, dated 1 May 1963, including the supplement attached thereto, said documents being incorporated by reference, together with such changes as may be agreed to between the Contractor and the Contracting Officer.

Item 2 - Provide mock-ups of the cameras as follows:

a) One (1) each Thermal Model Test Unit which, by scale and general construction, simulates the Strip Camera.

b) Two (2) each Space Mock-ups which simulate the outer configuration, one (1) for use by LMSC and one (1) for use by Itek.

c) Two (2) each Structural Mock-ups, including dollies, each of which is weight and mass similation of the Camera. One (1) for use in Contractor Qualification Program and one (1) for use by LMSC.

Item 3 - Contractor shall furnish the following GHE and GSE:

a) Fabricate one (1) each Instrumentation Console.

b) Fabricate two (2) each Control and Power Consoles.

c) Fabricate one (1) each TM Checkout Console.

d) Fabricate three (3) each modification units for Checkout Consoles

e) Fabricate two (2) each modification units for Control and Power Console.

f) Design and fabricate six (6) each Test and Assembly Dollies.

g) Design and fabricate three (3) each interface templates.

h) Design and fabricate two (2) each Strip transit cases.

i) Fabricate three (3) each Cassette transit cases.

j) Design and fabricate 100 sets each film transit case spiders and protective flanges and recycle.

k) Design and fabricate three (3) sets vertical and horizontal installation fixtures.

l) Design and fabricate one (1) each Photo Altitude Thermal Simulation (PATS) Chamber including seismic block and environmental conditioning for Boston.

m) Design and fabricate one (1) each Strip Atmospheric Dynamic Resolution Tester excluding seismic block and environmental conditioning for A/P.

Item 4 - Provide LMSC with two (2) additional Strip Camera cassette assemblies for test and checkout purposes.

Item 5 - Furnish 100 film supply spools for the Strip Camera. Delivery shall be made in accordance with the Film/Spool/Transit Case schedule developed by the Contractor. Contractor shall provide protective flanges for the GFE transit cases. Spools will be recycled.

Item 6 - Furnish necessary field engineering services to support the cameras at LMSC and VAFB in accordance with Detailed Field Engineering and Flight Support Work Statement, dated 14 May 1962.

Item 7 - Contractor shall furnish spares in accordance with the following:

a) On or before the eighth (8th) contract month, Boston shall furnish the Systems Engineering Contractor (SE) seven (7) copies of a production list containing the part number, description, and quantity of those parts deemed necessary by Boston to support the equipments after shipment from Boston, considering the delivery schedule and two (2) facilities. This list shall indicate those long-lead-time items already released to support the equipments. Subsequent lists, if necessary, will be submitted on a monthly basis.

b) If within thirty (30) days from the date of submission, the SE and the Customer has neithor approved nor disapproved all the items contained in such production lists, those items shall be deemed to have been authorized for provisioning purposes. In the event items are disapproved by the Customer, procurement activity shall be terminated where necessary.

c) Spares shall be shipped to the Associate, F.O.B. the Associate's facility for maintenance of accountability in a segregated Stores Area. The parts shall be available to Boston's Field Engineering and Flight Support Group to replace those parts as may be necessary to certify flight readiness of the cameras.

d) The costs, fee, and delivery schedule of these spares shall be determined at a later date.

Item 8 - Contractor shall perform Inspection, Qualification and Acceptance tests in accordance with Specification No. 49849, and the following:

a) Inspection of the material to be delivered from Boston shall be at a level deemed necessary by Boston and approved by the Government to insure performance. Boston shall provide additional inspection services in the event performance verification or rework is necessary to such material after acceptance and delivery. Boston shall also verify that no damage in transit has occurred to its materials after shipment from one facility to another.

b) Shipment is F.O.B. Lexington, Massachusetts, via such carriers and to such destinations as may be designated by the customer. Boston will provide instrument transit cases.

c) Final acceptance of equipment and materials to be delivered shall be at Boston. The Systems Engineering Contractor (SE) and other Customer's representatives will be notified five (5) days prior to the beginning of final acceptance tests. These tests shall be administered in accordance with the approved Acceptance Test Procedures. Requests for waivers on end item equipment deliveries shall be submitted to SE/TD for resolution. The execution of a DD Form 250 by Itek, which may contain concurrence signatures of SE and other Customer's representatives, shall constitute final acceptance. Copies of the DD Forms 250 will be forwarded to the Contracting and Finance Officers.

d) All Qualification Test Specifications and Procedures (QTS/QTP) shall be prepared by the Contractor and the QTS shall be approved by SE/TD prior to the performance of the Qualification Test. The Acceptance Test Specification is as contained in Specification No. 49849.

Item 9 - Contractor shall furnish the following reports and attend required meetings as follows:

a) Weekly TWX progress report - to be forwarded to SE/TD on Wednesdays and shall report significant highlights of development for the preceding week - ending Saturday.

b) Monthly TWX Financial Report - to be forwarded the 20th of each month for the preceding Boston accounting month.

c) Weight Report - to be forwarded every two (2) weeks to the Systems Engineering Contractor showing the current weight estimate and first and second moments of inertia. Should the details of the report be unchanged, a TWX statement to that effect will be forwarded in lieu of the report.

d) System Qualification Test Report - to be forwarded to the Systems Engineering Contractor two (2) weeks or sooner after completion of each major test phase (i.e., System shake, System photo/thermal/altitude, etc.). A consolidated, summarizing report shall be forwarded forty-five (45) days after the System Qualification Test Program.

e) Subsystem and Subassembly Qualification Test Reports - to be forwarded to SE/TD two (2) weeks or sooner after completion of each major test phase. A consolidated, summarizing report shall be forwarded forty-five (45) days after the Subsystem Qualification Test Program.

f) Acceptance Test Reports - to be forwarded as part of each Camera logbook.

g) Post-flight Engineering Analysis Report - ten (10) copies to be forwarded to SE/TD upon completion of each analysis. LMSC will furnish Contractor with copies of all pertinent telemetering data obtained during flight for engineering analysis by Contractor of camera performance.

h) Systems Engineering Meetings shall be held once each month alternately at Associate and Boston. Such meetings shall be chaired and minutes prepared and distributed by the Systems Engineering Contractor. Contractor shall present such briefing aids and data as required.

i) Provide the Systems Engineering Contractor with documentation of each Strip Camera consisting of:

1. Strip Camera Logbook.
2. Calibration data.
3. Strip Camera Electrical Schematics as wired (three (3) each). These drawings may be red-lined.
4. Results of Acceptance Tests.

B. <u>Delivery</u> - Based on a contractual go-ahead of 1 June 1963 the Contractor shall deliver the work called for above in accordance with the following schedule. Unless otherwise specified, acceptance and inspection shall be at Contractor's plant or plants of shipment made F.O.B. Contractor's plant, Lexington, Massachusetts.

Item 1 - Strip Camera, four (4), (less supply spools) (including Cassettes).

Serial No. 3	1 August 1964
Serial No. 4	1 October 1964
Serial No. 1	1 December 1964
Serial No. 2	1 February 1965

Item 2 - a) Model Test Unit (Boston)

b) Space Mock-up, Strip Camera - two (2) each - (Boston) 15 October 1963 - (A/P) 1 November 1963.

c) Structural Test Model, Strip Camera - two (2) each, including dollies - (Boston) 3 January 1964 - (A/P) 2 March 1964.

Item 3 - Contractor shall deliver GHE and GSE as follows:

	A/P	B	Date
a) Fabricate one (1) each Instrumentation Console.		1	14 February 1964
b) Fabricate two (2) each Control and Power Consoles.		2	31 January 1964 2 March 1964
c) Fabricate one (1) each TM Checkout Console.		1	33 April 1964
d) Fabricate three (3) each Modification units for Checkout Console.	2	1	15 May (1) 15 June (2)
e) Fabricate two (2) each Modification units for Control and Power Consoles.	1	1	1 May 1964 1 June 1964
f) Design and fabricate six (6) each Test and Assembly Dollies.	2	4	28 February 1964 (2) 1 April 1964 1 May 1964 1 August 1964 1 October 1964
g) Design and fabricate three (3) each interface templates.	2	1	31 January 1964 (3)

		A/P	B	Date
h)	Design and fabricate two (2) each Strip transit cases	2		1 August 1964 1 October 1964
i)	Fabricate three (3) each Cassette transit cases.	3		16 March 1964 15 April 1964 1 August 1964
j)	Furnish 100 sets each film transit case spiders and protective flanges and recycle.			Per Plan
k)	Design and fabricate three (3) sets vertical and horizontal installation fixtures	2	1	1 June 1964 1 August 1964 1 October 1964
l)	Design and fabricate one (1) each Photo Altitude Thermal Simulation (PATS) Chamber.		1	19 June 1964
m)	Design and fabricate one (1) each Strip Atmospheric Dynamic Resolution Tester.	1		3 August 1964
Item 4 -	Two (2) Cassette Subassemblies	2		16 March 1964 15 April 1964

Item 5 - Film Supply Spools

Per Integrated Spool/Film/Transit Case Plan.

Item 6 - Field Engineering Services shall be furnished as required for the period of performance of this Contract, contemplated to be through 28 May 1965.

Item 7 - Spare parts shall be delivered in accordance with Item 7 of Paragraph A of this Work Statement.

Item 8 - Qualification, Inspection and Acceptance shall be performed in accordance with Item 8 of Paragraph A of this Work Statement.

Item 9 - Reports: Deliver in accordance with a. through i. of Item 9 of Paragraph A of this Work Statement.

C. Furnished Equipment

Item	Description	Location	Delivery Date
1.	Film and film transit cases as re-required for testing and checkouts	Boston	Per Plan
2.	Stellar/Index Cameras, four (4), including Transit Cases, Supply Spools and Stellar/Index Cassettes.	A/P	1 August 1964 1 October 1964 1 December 1964 1 February 1965
3.	System outer skin, Fairing Subassembly, adapter, and other parts suitable for Camera qualification.	Boston	3 July 1964
4.	Contractor will be furnished and is also authorized to use on a no-charge-for-use basis such items as special tooling, test equipment, ground handling equipment, ground support equipment, and facilities generated under Contract BT-1943 and any other contract between the parties hereto.		

REVISIONS

SYM	DESCRIPTION	DATE	APPROVAL

Specifications Procedures

Engrg	[redacted]		TITLE
Engrg			SPECIFICATION FOR STEREO STRIP AND STELLAR/INDEX CAMERAS
Engrg		STATINTL	
Engrg			
Project			
QA App'd			
SE App'd			4 9 8 4 9
Issued	1 May 1963		Code Sheet 1 of 25

1.0 SCOPE

1.1 Objective: This specification covers the requirements for a high-acuity Stereo Strip Camera and associated stellar/index cameras. The camera is to provide programmed vertical and stereo photographs at a resolution level of 2 feet or better from 90 n. miles. The system is to be designed to be used in a light-tight structure and will allow recovery of the film only.

2.0 APPLICABLE DOCUMENTS

2.1 The following publications of the issue in effect as of date of issue indicated, shall form a part of this specification to the extent specified herein. In the event of conflicting provisions, the requirements of this specification shall prevail. See Appendix A.

Specification Number	Title	Date of Issue
MIL-STD-150A	Photographic Lenses	12 May 1959
6117B	Environmental Test, Specification	1 July 1960
MIL-E-1D	Electron Tubes and Crystal Rectifiers	31 March 1958
447969A	Systems Electrical Interface Specification	9 April 1962
1072045A	Cable Design Control Specification	8 December 1960
SP2-156	Electrical Interface	10 May 1962
49900	Interface Drawing	
	Spooled Film - 12"	
	Semi-Conductor X-Ray Inspection	

3.0 REQUIREMENTS

3.1 General

3.1.1 General Requirements: The cameras shall conform to the requirements of this specification.

3.1.2 Parts, Materials, Processes: Shall be consistent with flight objectives and good design practices. When and where applicable, MIL standards and specifications for space equipment shall be used as a guide.

3.1.3 Weight: Total weight of the Stereo Strip Camera including empty supply spool but excluding cassette shall not exceed 975 pounds. Maximum film capacity will be 80 pounds. The cassette shall not exceed 20 pounds. A stellar (attitude)/index (terrain) camera is provided for an additional 15 pounds.

3.1.4 Identification: Itek nameplates including main assembly part number and serial number will be supplied. The name "Itek" will not be indicated.

3.2 Selection of Specifications and Standards

3.2.1 Standard Parts: AN or MIL standard parts shall be used wherever possible.

3.2.2 Commercial Parts: In applications for which no suitable corresponding AN or MIL part exists or where they are not readily available, qualified commercial parts may be used.

3.3 Material

3.3.1 Metals: Metals shall be of the non-corrosive type or be suitably protected (subject to the thermal requirements) to resist corrosion during maximum service life. (Test, storage, and flight.)

3.3.2 Semi-Conductors: To aid in establishing a ground rule philosophy in semi-conductor selection, the following guides are offered.

3.3.2.1 Requirements and characteristics of MIL-E-1D must be considered minimum, and no component shall be used that is not vendor-certified or tested to the limits of that specification.

3.3.2.2 The environmental requirements of 6117 may be used as minimum levels, provided sufficient de-rating is applied to verify thermal competence.

3.3.2.3 All semi-conductors must be X-ray inspected per TD-55.

3.3.2.4 All electronic packages containing semi-conductors must be aged under simulated load for 200 hours before installation.

3.3.3 Electrical: Interface power and power distribution characteristics shall be as specified by 447969, System Electrical Interface. 447969 shall be used as a guide for Camera System power and signal distribution, shielding, and grounding.

3.4 System Design Objective: The camera subsystem shall satisfy the high-acuity Strip Camera concept and shall also include a stellar

(attitude recording)/index (high resolution terrain) camera, and a take-up cassette which will be independently mounted in a recovery capsule. Electrical circuits, controls, and cycling programmer capable of operating on commands from the vehicle programmer shall be included. Instrumentation which will provide inputs to the vehicle telemetry system to monitor critical functions of cameras while in flight will be established as indicated in SP2-156.

3.4.1 Photo Quality: Strip photographs will be of such quality as to permit the resolution of an adequately illuminated Air Force test pattern at a level of 72 l/mm. Tests shall be conducted for qualification and acceptance of equipment using an Air Force test pattern of the type defined in MIL-STD-150. Target contrast shall be that required to present 2:1 contrast at the camera.

3.4.2 Location Accuracy: The system design objective for location accuracy of any point on the Strip photograph shall be ± 2 miles.

3.4.2.1 Time recording to an accuracy of 10 milliseconds will contribute a maximum uncertainty of ± 1/20 mile.

3.4.2.2 Positioning of the optical axis to within ± 15 minutes of arc will result in a possible error of ± 1/10 mile.

3.4.3 Lifetime: The mission life will be one to four days during which photographs can be taken at intermittent times.

3.4.4 Swath Width: The Strip Camera shall provide ability to photograph selected target areas having a nominal swath width of 6.9 n. miles at an altitude of 90 n. miles and having photographic quality per paragraph 3.4.1.

3.4.5 Roll Positioning: Roll positioning of the camera will be provided for selection of targets not directly beneath the flight path. The maximum roll angle to be provided will be 30 degrees. A signal indicating the angle of roll with respect to vertical will be provided in discrete positions of $\frac{1}{4}^{\circ}$ increments to allow correction of the IMC system and to film-record the roll angular command in the auxiliary data block of the S/I unit. The nominal response time for roll positioning shall be 30 seconds from -30 to +30° roll.

3.4.6 Continuous Cover: Once placed in operation, the camera shall have the ability to operate in a continuous manner for a maximum of 20 minutes during the mission duty cycle.

3.4.7 Stereo: Fore and aft stereo with 12° stereo convergence will be provided accomplishing a strip stereo pair of 18 n. miles length (from 90 n. mile altitude).

TITLE
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3.4.8 Programming: The orbital programmer will be used for commanding operation.

3.4.9 Environmental Performance: The camera subsystems shall perform within the limits established in this specification when exposed to any natural combination of the environments specified.

3.5 Vehicle, System Characteristics, and Interface

3.5.1 V/h for IMC: Ground selection of a suitable time varying V/h ramp will be required via real time command. The system will be capable of accepting commands in the V/h range .02 to .06 radians/second and will accomplish IMC. A minimum of 10 ramps will be provided. These ramps will be adjusted prior to flight to narrow the design V/h range for improved V/h accuracy. Ramp repeatability, once set, shall be one (1) percent. The system shall be capable of operating during either increasing and/or decreasing V/h conditions using a cosine ramp.

3.5.2 Vehicle Stabilization Requirements (1.65 values)

3.5.2.1 Angular Deviations

Roll ± ½ degree

Pitch ± ½ degree

Yaw ± 1/3 degree (corrected for earth's rotation). Capability to change the yaw of the vehicle from 0 to 3.6 degrees at a rate of 0.16 degree/minute commensurate with the inclination angle will be provided by the associate.

3.5.2.2 Residual Angular Velocities

Roll - 3^{o}/hr.

Pitch -9^{o}/hr.

Yaw -3^{o}/hr.

3.5.2.3 Momentum Balancing: No momentum balancing is to be provided.

3.5.3 Camera Compartment Environment:

3.5.3.1 Pressure: The camera compartment will be unpressurized.

3.5.3.2 Temperatures: During photographic operation, temperature of the Strip Camera shall be maintained at 70 degrees F ± 10 degrees F. Gradients on the take-up cassette ranging from 20 degrees F to 180 degrees F can be expected during recovery. Gradients and transients affecting optics and structure maintaining focal length will be

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controlled to tolerable levels by thermal design. Thermal design shall:

a. Establish uniform ambient temperature of optics and structure to aid in maintaining focus using passive thermal control wherever possible.

b. Minimize optical component temperature gradients.

c. Provide cooling for camera electronics and electromechanical devices.

d. Provide thermal protection for the film near heat sources greater than 150 degrees F and maintain thermal stability of film areas.

To assure stable operational temperatures, emissive coatings and thermal insulation will be applied on those areas of the camera structure and components as shall be mutually agreed upon by Itek and the associate. Specific power dissipating components and temperature-sensitive components or subassemblies shall be the subject of special consideration for negotiation by the associate contractors with System Engineering.

3.5.3.3 Light-Tight: The associate structure which serves as a camera compartment will be constructed in such a manner as to prevent light other than image forming light from falling on and exposing the film at any time. Light boots within the camera to meet this requirement will be provided by Itek.

3.5.4 Auxiliary Data Film Record

3.5.4.1 Time Signal: A digital clock (associate-furnished) will operate in conjunction with the camera subsystem by supplying signals for illumination of 29 lamps in the data block of the stellar/index camera and will be used for time recording on the edge of the strip format. It will be capable of storing time unambiguously for a period of 5 days in increments of 0.01 second or less. A readout will be provided to transfer the clock reading to the film once per stereo pair, and a serial binary readout will be provided to transfer the clock reading via the telemeter. The clock error will not exceed 10 milliseconds in any 12-hour period after accounting for clock drift and offset. Serial clock readout will be put on strip photography under the mask.

3.5.4.2 Roll Steering: Lights indicating roll angle image motion correction will be provided in the S/I data block.

3.5.4.3 Attitude Information: The stellar camera, of the stellar/index camera subsystem will supply photographic records of roll and pitch positioning to 0.1 degree accuracy.

3.5.5 Electrical Power: SP2-156 delineates the electrical connectors that shall be provided.

3.5.5.1 Electrical Power (Maximum):

Power Source	V/h Generator	Cassette Heater Power	Required Camera Avg. Pwr. During Operate	Total Available Energy During 100/hr. Flight incl. Heaters
Plus 22.00 to plus 29.25 VDC unregulated		15w*	300w	1900 w/hrs.
Plus 28.3 VDC plus or minus 2.0 percent regulated			50w	1875 w/hrs.
Minus 28.3 VDC plus or minus 2.0 percent regulated			25w	125 w/hrs.
115V plus or minus 1 percent single phase 400 cps plus or minus 0.02 percent	10w for 40 min.*		35w	80 w/hrs.

*as programmed.

3.5.5.1.1 Starting Transient: Maximum starting transient load on the unregulated DC supply shall not exceed 500 watts and shall be limited in duration to a maximum of 1 second at the beginning of each operate period.

3.5.5.1.2 Recurring Peaks: Maximum recurring peaks shall not exceed 500 watts of unregulated DC not exceeding 500-millisecond duration during camera operation.

3.5.5.1.3 Noise Level: Past experience has indicated that considerable noise may be present in these sources. All electrical circuits and controls should

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be designed to be capable of operating the the presence of noise as high as 2.0 V (peak-to-peak) due to 2,000 cps regulation on the plus and minus regulated DC power supplies. Transients of ± 10 volts of 10-millisecond duration may be experienced.

3.5.5.1.4 Ascent Phase: If required during ascent, the vehicle will supply 50 watts of +28 volt unregulated power continuously and 150 watts of +28 volts regulated power immediately after launch to the camera subsystems. Should this power be required, all tests will be performed under simulated conditions of power.

3.5.6 Programmer: Camera ON/OFF operation, V/h programmer synchronization, max./min. exposure, discrete roll positioning command signals and stellar/index ON/OFF commands shall be provided by the command programmer.

3.5.7 Commands: Signals for the operation of the equipment must be obtained. The operation signals to be provided are as follows:

COMMAND	SIGNAL SOURCE	LOAD
ON/OFF	1 relay	1 amp. max.
V/h - IMC - Selection of best time function for internal V/h approximation. A pulse train signal will make this selection via real time command.	Command link	24-volt stepping switch coil
V/h Generator Command (ON/OFF)	1 relay	1 amp. max.
Max/Min Exposure Selection	1 relay	1 amp. max.
Stereo/Mono	1 relay	1 amp. max.
Roll Steering IMC control (during time camera rolled)	7 binary-coded relays	1 amp. max.
Stellar/Index Intervalometer Command (ON/OFF)	1 relay	1 amp. max.

3.6 Design: The Strip Camera is intended to provide high resolution photography of selected target areas. It is an integral system whose operation shall be sequence-programmed and automatic upon command, including film transport, IMC, and auxiliary data recording. The basic design utilizes a focal plane containing moving film with IMC accomplished by rotation of the drum proportional to V/h.

3.6.1 Configuration: The design of the camera shall be such so as to permit installation in an envelope as defined by Drawing Number 49900.

3.6.2 Mechanical Interface: In accordance with Drawing Number 49900.

3.7 Construction: Within the limits of weight and space available, construction techniques, processes, and materials shall be selected to provide the maximum in structural integrity for the environment to be encountered.

3.7.1 Suspension: The principle parts of the camera shall be designed for the Strip Camera to be operated as an integral unit. The principle parts of the camera are the primary mirror, the 45° mirror, the aspheric corrector plate, refracting correction assembly, roll steering IMC compensator, IMC drum and drive, slit width control, and film transport mechanism including supply spool, film "dancer" loops and associated parts and drive mechanism, and a take-up cassette including spool and drive located in the recovery capsule. The Strip Camera shall be supported by the external skin of the vehicle and held in such a way to maintain alignment with the cassette and the stellar/index subsystem.

3.7.2 Maintaining Focus: The structure shall establish and maintain the distance from the nodal point to the film to the accuracy required to attain the specified resolution. Construction of the structure maintaining focal length shall ensure that the spacing to the film will not be changed due to launch acceleration, vibration, and shock. The construction and materials shall maintain focus during and subsequent to the uniform ambient temperature variations expected.

3.7.3 Film Thermal Shielding: Film paths and equipment near high-temperature external skin shall be properly thermally shielded if required.

3.8 Performance

3.8.1 Photographic Quality: The high-acuity Strip Camera, when operated, will produce a minimum degradation of static optics/film resolution. The design objective shall be 90 percent of the static LWAR optics/film resolutions obtained on the optical test collimator. The camera shall produce photographs with an LWAR resolution of 70 lines/mm or greater when operated under simulated flight condition utilizing the DRT with moving 2:1 contrast Air Force test pattern as defined in MIL-STD-150. (LWAR-AWAR for linear aperture.) Target contrast shall be that required to present 2:1 contrast to the camera.

3.8.2 Image Motion Compensation Accuracies: The image motion compensation mechanism and drive system shall have performance compatible with the design requirement pertaining to photographic quality.

3.8.3 IMC Drive Smoothness: The IMC drive system shall be smooth such that no objectionable banding occurs on the photography of ground scenes. For measurement purposes, the amount of banding present will be determined using aastable diffuse DC light source or a strobe light.

3.8.4 Exposure Control Evenness: Banding caused by non-uniform IMC motion or slit variations shall be controlled to produce less than 0.15 Log E change in exposure. The Delta Log E exposure change shall be determined by reference to the straight-line portion of SO-132 sensitometric control film printed and normally processed.

3.9 Major Components: The high-acuity Strip Camera shall consist of:

3.9.1 Film

3.9.1.1 Base: The camera shall be designed to utilize SO-132/206 or equivalent thin base (0.0035-inch) polyester film. Use of polyester materials varying in thickness between 1.8 and 4 mils will be a design objective.

3.9.1.2 Emulsions: The camera will be capable of handling and exposing Eastman Kodak films Special Order 132/206 or other films having equivalent or better photographic emulsions and physical properties.

3.9.1.3 Width: The system will use 12-inch wide film.

3.9.1.4 Spooled Film: The spooled film shall be in accordance with Itek Specification _____.

3.9.1.5 Format: The format will be in accordance with Itek Drawing Number _____.

3.9.2 Film Transport System: Film will be stored on supply and take-up spools. During camera operation, these spools will be driven at essentially constant speed which will be determined by the required cycling rate. (Proportional to V/h.) An IMC drum will meter unexposed film. The film on the drum will be held under tension during the photography. Dancer loops will be utilized to maintain tension and serve to decouple the IMC drum from the spool drives. Supply and take-up spools will be controlled in a manner to maintain the proper amount of film in the dancer

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loops, thus preventing slack loops or excessive film tensions. The film path will be designed to ensure proper tracking of the film and to eliminate the possibility of film tear or damage to the emulsion. The film transport system will be designed to minimize static discharge in the active format area in aerial scenes.

3.9.2.1 Allowance for Film Splices: The film handling system and guides shall be designed to allow for smooth passage of the required number of proper film splices expected in each roll of operational film. The film transport shall be capable of passing film that has been properly butt-spliced with 1-inch wide polyester film tape (Minnesota Mining and Manufacturing Company, Type Number 850 or equivalent).

3.9.2.2 Rollers: All rollers in the film transport mechanism shall be consistent with good design practice determined by the type of film to be used. A minimum diameter of one inch shall be used wherever possible.

3.9.2.3 Film Loading: The camera shall be capable of being loaded in subdued light using live film protected by 30 feet of leader.

3.9.2.4 Camera Start: From the time the start sequence command is received, the camera system shall be up to speed in approximately two seconds.

3.9.3 Supply and Take-up Spools

3.9.3.1 Capacity: Approximately 80 pounds (3,300 feet) of thin-base Estar 12-inch film (3½ mil).

3.9.3.2 Interchangeability: Spools will be removable and interchangeable between cameras.

3.9.3.3 Flanges: The flanges will be removable from the hub.

3.9.4 Cassette

3.9.4.1 Basic Design: The cassette will consist of the take-up spool and film take-up drive system for the Strip Camera mounted in a unit structure to allow installation in the recovery system. The Strip take-up spool and drive shall be controlled by the Strip camera film transport mechanism. Consideration will be given in the cassette design for spool removal in dark conditions. The total power consumption of the cassette shall be held to a minimum.

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3.9.4.2 Configuration: The design of the cassette will conform to the basic configuration and space limitation as shown by Drawing Number _____. Provision will be made for mounting the cassette within the vehicle in accordance with the mounting provisions as shown in Drawing Number _____.

3.9.4.3 Instrumentation

3.9.4.3.1 Thermal Instrumentation: One Ruge BN 2400 resistance thermometer will be installed in the cassette.

3.9.4.3.2 Remote Film Footage Indication Requirement: The take-up spool shall be provided with a transducer and the necessary electrical connections to permit remote indication of the amount of 12-inch film that is on the take-up spool at any time during the operation. This shall be accurate within 5 percent over the total spool radius.

3.9.4.4 Design Requirements:

3.9.4.4.1 Cassette Weight: The weight of the complete cassette with empty spools without film shall be held to a minimum and shall not exceed 20 pounds.

3.9.4.4.2 Film Loading: The cassette shall be assembled with polyester leader attached to the spool and threaded through the film handling system with six feet of leader external to the cassette film entrance slot. This leader shall be spliced to the camera film for final assembly and testing purposes.

3.9.4.4.3 Film Capacity: The cassette shall contain a film spool of special design with a minimum diameter core and a maximum film capacity.

3.9.4.4.4 Strip Anti-Backup Device: The cassette shall be designed to incorporate a brake in the spool drive system to prevent the take-up spool from unwinding. This brake shall be capable of being released for test and checkout purposes by applying 28 volts DC on an appropriate pin connection. The brake shall be mechanically engaged when the voltage is removed.

3.9.4.4.5 Cassette Heaters: Any required heaters, to maintain 70 ± 10 degrees F as may be specified by SE, shall be Itek's responsibility. The heater circuit will be on unregulated DC. Heaters will be controlled by an internal thermostat. Heater power will not exceed 15 watts.

3.9.4.5 Strip Take-up Performance: The take-up shall be capable of taking up the required amount of film as specified and shall be able to be started and stopped at least three hundred times during the taking up of a complete four-day roll of film under simulated duty cycle. The acceleration time shall be such that no slack loop will be formed during camera system operation. Film tension shall at all times be maintained.

3.9.5 Optical System: Specification MIL-STD-150 shall be used as a guide in the design, manufacturing, and testing of the optical system.

3.9.5.1 Optical Characteristics: The optical characteristics shall meet the photo quality requirements of paragraph 3.4.1 when using the photographic film supplied per paragraph 3.9.1.

3.9.5.2 Optics - 150" f/5: The resolution shall approach diffraction limited performance at high contrast. Each lens will have focal length of 150 ± 0.75 inch. Custom assemblies may be required and hence need not be interchangeable. The focal length will be maintained at operational altitude and temperature of 70 ± 10 degrees F (see paragraph 3.5.3.2).

3.9.5.3 Mirrors: Every effort shall be made to minimize temperature gradients through thermal design, specifying shielding, etc.

3.9.6 Photographic Filter: A photographic filter shall be mounted in the optical path. This filter shall not degrade the photographic image when the camera is used for its intended purpose. The filter shall be of the proper value for the selected film emulsion to be used as a haze filter (similar to Wratten 12).

3.9.7 IMC Drive: An IMC drive and shutter mechanism will be provided to drive the film past the exposure slit. Speed will be proportional to V/h. IMC speed during exposure will be held constant to meet the requirements of paragraph 3.8.3 and 3.8.4 to provide good positional determination and to minimize IMC error.

3.9.8 Image Motion Compensation System: The cameras will be designed for a median V/h = .04 (Range .02 - .06) radian/second. Upon receipt of proper IMC function selection, the system will compensate for ground motion.

3.9.9 Exposure: Exposure shall be accomplished by utilizing a focal plane shutter. Exposure time may be varied by command between a choice of two slit widths which are selectable on the ground within the design range.

3.9.10 Vector Detector: An image motion detector will be provided to sense relative motion. The along track signal will trim IMC drum speed to its correct value and a cross track signal will be derived to be furnished to the vehicle for yaw correction. ½% V/h or better is the specified accuracy.

3.9.11 Telemetering Data Transducers: In accordance with SP2-156 Electrical Interface.

3.9.11.1 Thermal Instrumentation: Ruge BN 2400 resistance thermometers or equivalent will be installed in the camera to monitor the temperatures of critical structures and components. Temperature sensors shall be located as mutually agreed upon between Systems Engineering and associate contractors.

3.9.11.2 Functional Instrumentation: As defined in SP2-156, Electrical Interface. Instrumentation will be re-identified and may be substituted.

3.10 Stellar/Index Camera Subsystem

3.10.1 General: Itek shall supply a Stellar/Index Camera subsystem under separate contract. This subsystem will provide a photographic record to permit indexing and correlation of the Strip reconnaissance photography with local mapping systems by image matching. A simultaneous star photograph will permit accurate determination of vehicle attitude. A time label shall be recorded with the index format. LMSC shall provide a 29-bit time word to the (stellar/index) camera from the digital clock upon interrogation by the camera.

3.10.2 Stellar/Index Control and Programming: The associate shall provide a signal to initiate and continue operation of the Stellar/Index Camera Subsystem, as required throughout the mission. The Strip camera will act as the intervalometer, proportional to V/h, and provide all subcycle commands required by the stellar/index camera, whether or not photography is being accomplished. Stereo/index photography will be accomplished at a ratio adequate to insure nominal 55% overlap.

4.0 TEST REQUIREMENTS

4.1 General: The tests listed are to be performed in accordance with the requirements stated within this specification.

4.1.1 Test Location: Itek Laboratories, Lexington, Massachusetts.

4.1.2 Witnessing of Tests: Tests may be witnessed by the following:

Systems Engineering Contractor (SE)

Itek-authorized representatives

Other personnel designated by customer.

4.1.3 Records of Tests and Reports: Test data shall be recorded. The contractor shall prepare test reports covering the results of tests required in this specification referencing the results of each test to the applicable test specified herein.

4.1.3.1 Camera Subsystem Qualification Test: All qualification test results shall be reported to the Systems Engineering Contractor, giving in detail all failures, repairs necessary, and malfunctions not resulting in failure. "Failure" is defined as being caused by the camera and "malfunction" is defined as being caused by GSE, personnel, procedure deviation, etc.

4.1.3.2 Subassembly Qualification: Reports on subassembly qualification tests shall be submitted to Systems Engineering Contractor and the customer.

4.1.3.3 Acceptance Test: The acceptance test shall be reported to the Systems Engineering Contractor.

4.1.4 Test Conditions: Applicable test conditions specified in 6117 shall be used.

4.2 Classification of Tests: Inspection and testing shall be classified as follows:

4.2.1 Qualification

4.2.1.1 Camera Subsystem Qualification Tests: Qualification tests, or preproduction tests, shall be run by Itek in Boston on a complete camera subsystem, to demonstrate compliance with the subsystem performance requirements. The individual tests shall be run with no adjustments or repairs during the course of the test. If any modifications are necessary after the completion of any qualification test, the test must

be re-run, unless explicit waiver is granted upon demonstration that the modification will not affect the response to the particular test. The camera shall be qualified under the applicable portions of 6117, using environments specified for the "Payload Area".

4.2.1.2 Subassembly Qualification: Subassemblies of the Strip Camera subsystem shall be separately qualified under the applicable portions of 6117, using environments specified for Payload Area. Subassemblies need not be given qualification tests if prior qualification under test conditions at least as severe as required in this specification can be documented or if waiver is granted by SE/TD upon review. Specific acceptance must be granted by SE/TD for each subassembly not subjected to qualification. Parts must function correctly following exposure to qualification test requirements.

4.2.2 Acceptance Tests: Acceptance tests shall be run on production units to verify workmanship and operability. The individual tests shall be run with no adjustments or repairs during the course of the test. If any modifications or repairs are made following the completion of any acceptance test, all tests previously run on the unit must be repeated, unless an explicit waiver is granted by SE/TD, based on the demonstration that the modification or repair will not affect the response to the particular test or tests.

4.3 Qualification Test: The environments specified in 6117 are for ascent and on-orbit. After simulated ascent environment, satisfactory camera operation must be demonstrated. The shock in paragraph 4.3.2.1.2 is applicable to the cassette subassembly for recovery environment after which operation is not required but disassembly will be demonstrated. (See paragraph 3.9.4.1.)

4.3.1 Camera Subsystem Qualification Tests

4.3.1.1 Shock Test: The camera subassemblies shall operate after being subjected to the required shocks. Operating during shock is not required. The provisions of paragraph 4.9 of 6117 are applicable. Table III, Payload (preliminary) test conditions shall apply.

4.3.1.2 Vibration Test: The camera shall operate after being subjected to the required vibrations. Operation during vibration is not required. The provisions of paragraph 4.10 of 6117 shall apply and Table V with the following modifications.

4.3.1.2.1 White noise testing is not required.

4.3.1.2.2 Test levels and limitation shall be as follows:

	ITEM	AXES	LEVELS (30 min. Log Sweep each axis)	
Qualification Tests	Minor Assemblies Elec. and Mech.	X,Y,Z	5-20cps 20-1500 1500-3000	.5" D.A. 10 g 15 g
	Major Subassembly	X	5-12cps 12-400 400-3000	.5" D.A. 4 g 7.5 g
	Optical Bar Transport Spool & Drive Cassette	Y,Z	5-9cps 9-250 250-400 400-3000	.5" D.A. 2 g 4 g 7.5 g
	STM	X,Y,Z	5-9cps 9-250 250-400 400-3000	.5" D.A. 2 g 4 g 7.5 g
	Complete Unit	X	15-400 400-2000	1.5 g 3.0 g
		Y,Z	15-400 400-2000	1.0 g 3.0 g
Accept. Test	Complete Unit and Lens Only	X,Y,Z	20-2000 15 min up, 15 min down	.25 to .5g

1) All "g" values are 0 to peak.
2) Resonances at frequencies other than those in the range from 15-25 cps shall be monitored and used to limit the input of the shaker so that above "g" values will not be exceeded. Resonances in the 15-25 cps range shall subject the equipment to design review.

4.3.1.3 Thermal Altitude: An endurance run, corresponding in duration to the mission duration shall be run,

at simulated altitude, and internal thermal environment specified. The duration of the test shall be 96 hours. The operation of the equipment will approximate the normal duty cycle. The test shall be run using a simulated vehicle power supply. No adjustments shall be made during the test. Loss of altitude during the test, to pressures greater than 0.001 mm Hg shall invalidate the test. At least 48 hours of the normal duty cycle during this test shall be at maximum cycling speed. The test shall be run at a pressure of less than 0.0001 millimeters mercury absolute pressure. The equipment shall be mounted in vehicle fairing, and jig-type take-up cassette used. The temperature shall be maintained at 70 ± 10 degrees F for the duration of the test.

4.3.1.4 Voltage Sensitivity: Tests shall be run at high- and low-input voltages, with noise and ripple up to 2.0 volts peak-to-peak at 2000 cps on the power supply. The equipment shall be operated at atmospheric conditions, at both maximum and minimum cycling rates over the range of operating voltages specified in this specification.

4.3.1.5 Acceleration Tests: The camera shall operate after being subjected to the required accelerations. Operation during the acceleration phase is not required.

4.3.1.6 Optical Resolution: The camera shall meet the optical resolution requirements of this specification as stated in paragraph 3.8.1 of this specification. The optical resolution shall be measured at vacuum conditions. This test shall be run after the completion of all other tests.

4.3.1.7 Temperature Tests: The following tests will be accomplished to establish equipment operating capabilities at predicted extremes of temperature. It is recognized that subsystem performance parameters may be degraded since these temperatures are beyond normal operational design limits.

4.3.1.7.1 High Temperatures: The camera shall be operated after stabilization at high temperature. The equipment shall be operated at a temperature of 95 + 5 - 0 degrees F at a pressure of 0.001 mm mercury absolute for at least 5 minutes each at minimum and maximum cycling rates.

4.3.1.7.2 Low Temperature: The camera shall be operated after stabilization at low temperature. The equipment shall be operated at a temperature of 45 -5 +0 degrees F at a pressure of 0.001 mm mercury absolute for at least 100 cycles each at minimum and maximum cycling rates.

4.3.2 Subassembly Qualifications: Strip camera subsystem subassemblies shall be subjected to all tests called for in

Camera Subsystem Qualification Tests as outlined. However, alternate versions of the Thermal Altitude endurance run may be substituted where applicable.

4.3.2.1.1 Ascent Shock: The camera subassemblies shall operate after being subjected to the required shocks. Operation during shock is not required. The provisions of paragraph 4.9 of 6117 are applicable. Table III, Payload (preliminary) test conditions shall apply.

4.3.2.1.2 Recovery Shock: The cassette shall be capable of withstanding the following shock test with a full spool of film without damage to the film nor degradation of the information recorded thereon. It shall be capable, furthermore, of withstanding said shocks without structural alteration which would cause damage to the film or degradation of the recorded information during subsequent disassembly of the cassette. Subject the cassette to 3 shocks along each direction of both X and Y axes for a total of 12 shocks of 5g magnitude and 6 millisecond duration (half sine pulse). Subject the cassette to 20 g's for 3 shocks in each direction along X axis. Axes defined in 49900.

4.3.2.2 Altitude: The equipment shall be operated at a pressure of less than 0.0001 mm mercury absolute pressure, for a normal four-day mission.

4.3.2.3 Voltage Sensitivity: The equipment shall be operated at atmospheric conditions at high and low voltages required in paragraph 4.3.1.4.

4.3.2.4 Temperature Tests: The following tests will be accomplished to establish equipment operating capabilities at predicted extremes of temperature. It is recognized that subsystem performance parameters may be degraded since these temperatures are beyond normal operational design limits.

4.3.2.4.1 High Temperature: The equipment shall be operated at a temperature of 90 +5 -0 degrees F at a pressure of 0.0001 mm mercury absolute for 30 minutes.

4.3.2.4.2 Low Temperature: The equipment shall be operated at a temperature of 45 +0 -5 degrees F at a pressure of 0.0001 mm mercury absolute for 30 minutes.

4.3.2.5 Electronic Package High and Low Temperatures: Electronic packages shall be run for 30 minutes under simulated load and mounting, after stabilization at a pressure of 0.001 mm mercury absolute at 125 ± 5 degrees F. They shall also be subjected to the same test conditions except temperature stabilization shall be 40 +0 -5 degrees F.

4.3.2.6 Vibration Test: The subassemblies shall operate after being subjected to the required vibrations. Operating during vibration is not required. The provisions of paragraph 4.10 of 6117 shall apply and Table V with the following modifications: White noise testing is not required. Test levels and limitations to be those in 4.3.1.2.1.

4.4 Acceptance Test Requirements

The camera shall be subjected to the following tests.

4.4.1 Electrical Insulation Tests: All electrical circuits shall be checked to the frame of the camera with a single application of 100 volts DC on 28-volt circuits and 300 volts DC on 115-volt circuits, and shall show a resistance of 1 megohm or greater. The wire harness shall have been tested to the limits of 1072045 after installation in the camera but prior to connection of subassemblies and components.

4.4.2 Mating and Alignment Test: The camera will be mated to a test fixture simulating the mechanical interfaces per _____. This test fixture will be a precision instrument and the camera must fit the interface without alteration of the fixture. The camera subsystem must align on all axes in accordance with this specification. Position of the camera alignment marks shall be checked with respect to the optical axis. These marks shall coincide with the optical axis within 15 minutes of arc and any misalignment shall be known to within 3 minutes of arc and recorded. Load the camera with a full spool of test film to be used in all succeeding tests.

4.4.3 Functional Operation Test: With the simulated electrical interface of the Checkout Console the camera will operate satisfactorily and respond to all operational and test commands. The camera will be operated at the extreme ends of mid-point of the V/h range. The camera shall be loaded with film and operated in conjunction with an actual take-up cassette in a positioning fixture. The camera shall operate satisfactorily for 1000 feet of film without an assist of any manner whatsoever. The camera shall be started and stopped at least twenty-five times without any erratic operation or mishandling of film. Any malfunction of loops, tracking or dancer rollers may be corrected but the complete test shall be re-run.

4.4.4 Power and TM Test: With the subsystem connected to the simulated electrical interface of the Checkout Consoles, a test shall be conducted to determine that subsystem circuits do not exceed the power requirements. Power and signal checks shall be made at designated connector pins of the Electrical Interface. Real time recordings of functional TM instrumentation at high and low ramp settings will be obtained to demonstrate satisfactory operation. Single point thermal instrumentation calibration will be accomplished. Three point data on serialized thermal

transducers will be furnished.

4.4.5 Vibration Test: The Strip Subsystem mounted on the test fixture shall be placed on a vibration table. Voltage will be applied at J101 per SP2-156 during vibration but the unit will not be operated. Sinusoidal vibration shall be applied along each of three mutually perpendicular axes, at 1/2 to 1 g peak-to-peak using a frequency sweep program from 20 to 2000 cps at constant octave sweep rate for 15 minutes, followed by a sweep from 2000 to 20 cps at constant octave sweep rate for 15 minutes. Resonances will be monitored and used to limit the input of the shaker to the levels specified herein. Dwell at resonance is not required.

4.4.6 Post-Vibration Visual Inspection: After the vibration test, the subsystem shall be inspected for any visual defects.

4.4.7 Post-Vibration Electrical Insulation Test: After the vibration test, all electrical circuits shall be checked to the frame of the camera with a single application of 100 volts DC on 28-volt circuits and 300 volts DC on 115-volt circuits, and shall show a resistance of 1 megohm or greater.

4.4.8 Post-Vibration Operating Test: After vibration test the subsystem shall be operated in accordance with paragraph 3.3. above.

4.4.9 Post-Vibration Photo Test

4.4.9.1 Resolution: The camera shall be mounted in the dynamic resolution tester, loaded with a test spool of unexposed SO-132 film and vacuum conditions less than 500 microns shall be obtained. The camera shall operate and photograph the test patterns under dynamic conditions, to demonstrate satisfactory operation and perform resolution tests in accordance with this specification. Using the resolution target (per para. 3.8.1), with the camera running at nominal V/h and minimum operational slit for SO-132, set DRT light source level for optimum exposure. Make three exposures on axis at each of the following field angles: 0^{o}, $\pm 1^{o}$, $\pm 2^{o}$ for a total of 5 angular positions. Process the film under controlled conditions and record gamma. Read the three target images in accordance with MIL-STD-150A recording the average of the two highest readings. Calculate and record LWAR.

4.4.9.2 Format Banding and Light Tightness: A fogging test of live film shall be administered to demonstrate light tightness of the subsystem using a simulated structure. The fogged film shall be inspected to ascertain that format dimensions are within the design accuracy required. Banding shall be shown to produce less than 0.15

Log E change. Determine delta Log E by reference to the straight line portion of SO-132 sensitometric control film printed and normally processed under controlled conditions recording gamma.

5.0 PREPARATION FOR DELIVERY

5.1 Packing and Packaging: Packing and packaging shall be adequate to protect all equipment when shipped or stored.

5.2 Handling, Mating and Checkout: Adequate protective devices will be supplied.

APPENDIX A

Exceptions to 2.0 APPLICABLE DOCUMENTS

1.0 Exceptions to 6117B:

a. Change paragraph 1.1.5 to read "AET Engineering Department of Contractor."

b. Delete paragraph 1.2.2.1 and substitute "Equipment shall be transported by military transport aircraft and motor vans. The equipment shall be protected and packaged to withstand such conditions as well as shock and vibration prevalent during shipping."

c. Delete paragraph 1.2.3 and substitute "Contractor storage facilities will ordinarily be air-conditioned. However, heat and high humidity may occur, and equipment should be able to withstand such conditions."

d. Delete paragraphs 1.2.4.1, 3.2.1.4, 3.2.1.5, 4.3.1, 4.4, 4.6, 4.7, and 4.8.

e. Change paragraph 2.1 to read "MIL-E-5272C (ASG)-13 April 1959 and Amendment No. 1, 20 January 1960 - Environmental Testing, Aeronautical and Associated Equipment, General Specification for" - all other MIL standards not applicable.

f. Delete paragraph 2.4.

g. Delete paragraphs 3.2.1, 3.2.2.2, and 3.2.2.3.

h. Change paragraph 4.1.1 to read "humidity of not more than 70 percent."

i. Paragraphs 4.3 through 4.8.3 - not applicable.

j. Delete paragraph 4.9.1 and 4.9.2.

k. Delete paragraph 4.10.1.

l. Table VI - not applicable.

m. Paragraph 4.10.2 will be used as a guide in preparing the Qualification Test Specification, Procedures, and design of the qualification fixtures.

2.0 Exceptions to 447969A:

2.1 The following techniques, which have proved effective in the past will be employed for grounding and shielding and will satisfy the general intent of 447969A and the requirements of this Specification.

2.1.1 The chassis will in no case be used as a circuit path. There will be a minimum isolation of 1 megohm between chassis and all power and signal circuits.

2.1.2 Loads on each power category will be kept separated throughout the camera. That is, regulated return, unregulated return, 400-cycle return and TM return will not tie to each other in the camera.

2.1.3 No attempt will be made to float electronic chassis with respect to the structure.

2.1.4 Each electronic chassis will be tied electrically to a central chassis ground point.

2.1.5 All 400-cycle circuits will be run twisted shielded.

2.1.6 All shields at the interface, if picked up in the camera, will be carried through interface connectors to the load or signal source without commoning to other shield circuits and without being tied to any power return circuit or chassis.

2.1.7 Connector pins will be allocated to maintain spacing between power and signal circuits.

2.1.8 Shields will be grounded at but a single point. Shields will be insulated from each other in cable bundles.

2.1.9 Power distribution to subsystems not essential to the primary flight objective will be fused.

2.1.10 Wire sizes will be selected consistent with MIL-W-8160C.

2.1.11 Radio interference criteria will be applied for the entire camera rather than on a component or subassembly basis.

2.1.12 The overall schematic will show the shields and grounds distribution details.

2.1.13 The following techniques will be employed in the camera to reduce radio interference at its source.

2.1.13.1 Dual LC filters will be used in conjunction with all DC motors.

2.1.13.2 Diodes or arc suppressors will be used to reduce inductive transients on relay coils, brakes, and solenoids.

2.1.13.3 Mounts for motors, etc., are spot-faced to provide good contact with the frame.

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